interest is contagious, and so he firmly established the Harrow Scientific Society, as he had helped to found the Junior Scientific Society at Oxford. Though a chemist by training—he was a fellow of the Chemical Society—his activities were at least as wide as those of the British Association, of which he was a keen supporter. His knowledge of palæontology and of archæology was deep. Few indeed were the branches of learning along which he could not guide a young inquirer, so he fulfilled perfectly the offices of librarian and curator of the school museum. The municipal life of his adopted town and county owe much to Mr. Lascelles, whose many friends will ever remember his genial personality with gratitude.

PROF. W. FOORD-KELCEY, professor of mathematics at the Royal Military Academy, Woolwich, since 1903, died on January 3 at the age of sixty-seven. He was a scholar of Exeter College, Oxford, and obtained a First Class in the Final Mathematical School in 1877. He joined the Royal Military Academy as instructor in mathematics in 1878; later he was called to the Bar, and for a time combined legal work with teaching, but eventually gave up the former. Altogether, Prof. Foord-Kelcey was at the Academy for forty-three and a half years, and nearly all serving gunner and sapper officers knew him. He was a man of great ability with brain, hand, and eye, being a first-rate practical mechanic. He had a wide knowledge of mechanism, and retained his interest in the teaching of mechanics to the last. He was due to retire in the summer of this year, and in him the Royal Military Academy has lost a great personality.

FATHER GIUSEPPE LAIS, S.J., whose death in Rome was recently announced, was born in Rome in 1845. He was the author of a very long series of papers dealing with meteorology, both mediæval and modern, solar eclipses, comets and meteors, and astronomical photography. He published some little-known meteorological records of the sixteenth and seventeenth centuries. He took a deep interest in the astrographic chart, and published researches on the best methods of measuring and developing the plates. As vice-director of the Vatican Observatory since 1903 he has had a large share in taking the plates of the zone allotted to that observatory. He was also interested in the question of calendar reform, publishing papers on this subject in 1892 and 1901. Father Lais was for many years vice-secretary of the Accademia dei Nuovi Lincei, Rome.

WE regret to announce the death on January 15, in his ninetieth year, of SIR JOHN KIRK, G.C.M.G., K.C.B., F.R.S., chief officer and naturalist of Livingstone's expedition to the Zambezi in 1858–63, during which he made large collections and many observations of great scientific value. He was the author of numerous contributions to the botany, zoology, and geography of Eastern tropical Africa.

WE regret to see the announcement of the death on January 8, at eighty-six years of age, of PROF. J. H. COTTERILL, F.R.S., formerly professor of applied mechanics, Royal Naval College, Greenwich.

Notes.

THE gold medal of the Royal Astronomical Society has been awarded to Dr. J. H. Jeans for his contributions to theories of cosmogony.

M. RAYMOND POINCARÉ, who has succeeded M. Briand as Prime Minister of France, held that office in the years 1911–13, and was President of the French Republic in 1913–20. He is a brother of M. Lucien Poincaré, the distinguished official head of the University of Paris, who died nearly two years ago, and a cousin of the great mathematician and philosopher, Prof. Henri Poincaré, who died in 1912. In 1914 M. Poincaré was elected Lord Rector of the University of Glasgow, and in November, 1919, he delivered an inspiring address on Franco-Scottish unity to an assembly of four thousand students and other members and friends of the University.

THE Strangers' Hall, Norwich, an interesting old city merchant's house, with groined undercroft, fifteenth-century banqueting hall, and other panelled rooms of later date, has been offered by its owner, Mr. Leonard G. Bolingbroke, to the Corporation of Norwich for the purpose of an English Folk and Historical Museum, in conjunction with the Norwich Castle Museum. Mr. Bolingbroke has also offered his collection of old domestic appliances and other "bygones" illustrative of the various phases of a middle-class Englishman's home during the last four or five centuries, which will find a fitting environment in the various rooms of the house. While the aim of the museum will be historical rather than scientific, there will be found many exhibits of interest to students of the early history and development of such subjects as the production of light and fire, domestic cookery, and other kindred objects.

THE annual meeting of the Institute of Metals will be held in London on March 8–9, when ten important papers are to be presented for discussion. The annual May lecture will be delivered on May 3 by Sir Ernest Rutherford on "The Relation of the Elements." The autumn meeting will be held at Swansea on September 20–22. A large gathering is expected in this important metallurgical centre, and the Mayor and corporation have extended a very hearty invitation to members of the institute. Last year the membership of the institute increased from 1298 to 1410—a record year's growth. Such an increase, occuring during a year of great trade depression, indicates that makers and users of non-ferrous metals and alloys are on the alert to take advantage of the scientific information obtainable through association with the institute that exists to foster their interests. It is largely through the adoption of more scientific methods of manufacture that the British manufacturer will be able successfully to meet foreign competition, and it is just here that invaluable service is being rendered by our scientific institutions.

THE officers of the Ramsay Memorial Fund announce that the Dean and Chapter of Westminster have consented that a tablet containing a medallion portrait of Sir William Ramsay should be placed in Westminster Abbey in the place immediately below that occupied by the Hooker tablet. The tablet is being executed by Mr. Charles Hartwell, A.R.A. It is anticipated that the unveiling will take place in October next. An announcement will be made on the subject in due course. At the request of the Ramsay Memorial Committee a commemorative medal of the late Sir William Ramsay has been executed by the distinguished French sculptor, M. Louis Bottée. The medals will be struck shortly in London when it is known approximately how many will be required.

ON January 2 occurred the centenary of the birth of Rudolf Julius Emmanuel Clausius, the distinguished mathematical physicist and the predecessor of Hertz in the chair of natural philosophy at Bonn. The son of a pastor and schoolmaster, Clausius was born at Koslin, in Pomerania, and after attending the gymnasium at Stettin, spent four years at Berlin, where he studied under Dirichlet, Steiner, Dove, and Magnus. Before going to Bonn he held appointments at the Royal Artillery School, Berlin, Zürich Polytechnic, and Würzburg University. Recognised as one of the founders of the science of thermo-dynamics, it was in his memoir to the Berlin Academy of Sciences in 1850 that he re-stated Carnot's principle in its correct form. To him is also due the conception of entropy. His chief work, "Die Mechanische Wärmetheorie," appeared in 1867. The kinetic theory of gases and the theory of electrolysis also owed much to his labours. Among his honours was that of the receipt of the Copley medal, while the Institution of Civil Engineers made him an honorary member. He was called to Bonn in 1869, served as Rector of the University during 1884–85, and died there on August 24, 1888.

IN his presidential address to the American Association for the Advancement of Science, delivered in December last at Toronto, Dr. L. O. Howard made some interesting remarks on the ages of presidents of the British and American Associations. The average age of the presidents of the British Association during the period 1895–1920 was sixty-one years and eleven months, and of those of the American Association sixty-one years and five months. The youngest president of the British Association during that period was fifty-three years of age, and Sir A. W. Rucker (1901), Sir J. J. Thomson (1909), and Prof. W. Bateson (1914) were each fifty-three years of age when serving as president. The oldest was Prof. T. G. Bonney (1910), whose address was delivered at the age of seventy-seven. The youngest of the American presidents were Minot and Richards, whose addresses were delivered at the age of fifty; and the oldest was Eliot, whose Philadelphia address was delivered when he was seventy-nine years of age. "We may safely assume," remarks Dr. Howard, "that the usefulness of the man past middle age is granted, and that, while he may not have the illuminative bursts of inventive or speculative genius which come to the younger man, he is better able to make the broad generalisations based upon accumulated experience—in other words, to prepare an appropriate presidential address as president of the British or the American Association for the Advancement of Science."

AT the Institution of Electrical Engineers on January 12 there was an interesting exhibition of instructive American cinematograph films. The first film, which was exhibited by Dr. Garrard, showed tests of high-tension switchgear. The experiments with switches were made with currents of the order of 100,000 amperes, the object being to find out how the apparatus withstood the enormous mechanical stresses set up by these very large currents. The films were first shown at the ordinary speed; they were then shown at a reduced speed, so that the various effects produced could be followed. The tests made on current and potential transformers showed clearly the types which withstood the stresses best. In some cases switching on the power produced effects similar to those produced by a high-explosive bomb. A noteworthy educational film called "The Audion" was also exhibited. It explained very clearly the operations which are believed to take place between the transmitter and the receiver in radio-telegraphy. The electrons are shown in active motion round the filament of a thermionic tube, and the artist shows by means of them the valve action of the tube. Similarly, the amplifying action of the grid is explained by the motions of the electrons. The currents in the antenna and the waves leaving it were also shown in motion, the whole producing a very lively representation of what takes place. The films were made by the Western Electric Co. of America for the instruction of their employees. Another film showed the building up of a telephone, all the various parts of it slowly and deliberately getting into their proper places apparently by their own agency.

THE annual meeting of the Mathematical Association was held on January 2–3, and Sir T. L. Heath was elected president as successor to the Rev. Canon J. M. Wilson. Papers were read by Sir George Greenhill on "Mathematics and Artillery: Before and After the War: A Review of the Outlook: Then and Now," and on "The Structure of the Atom" by Dr. J. W. Nicholson. Prof. C. Godfrey delivered an address on the importance of the introduction of vectors in the work of the secondary school—a subject on which several writers in the *Mathematical Gazette* have written strongly of late. Miss F. A. Yeldham's paper on "The Dalton Plan and the Teaching of Mathematics" aroused considerable interest; an animated discussion followed, with many inquiries as to the details of her experiences of the plan as at work in the Streatham schools. Prof. G. H. Hardy gave a most interesting address on the life and work of that Indian genius, the late Srinivasa Ramanujan, which was full of personal recollections. He set forth with consummate skill the nature of Ramanujan's researches, his successes, and his failures. He also made an eloquent appeal for a wide extension of education in India, assuring his audience that with such opportunities for the great peninsula as we enjoy here in the West there would soon be an Indian school of mathematics at least equal to anything that can be shown in Europe or America. Incidentally he condemned the folly of those who have decried the Germans as lacking in originality. The next paper was by Mr. A. Dakin, who pleaded with much effect that pure and applied mathematics should be taught and developed *pari passu* in boys' secondary schools. The meeting was brought to a close with a discussion opened by the Rev. E. M. Radford on the best ways of keeping teachers of mathematics in touch with modern developments and methods—a most important problem, and one for which a solution must be found in the near future.

IN an interesting paper contributed to the Journal of the Royal Anthropological Institute (vol. 51, part 1) Prof. F. G. Parsons arrives at conclusions, which may be quoted in his own words, in connection with the Long Barrow race, and its relationship to the modern inhabitants of London. He believes that "the shape of the skull is the result of vital or physiological forces, some of which we grasp feebly, and others which we do not understand at all as yet, acting on it for a very long time; but that shape, once established, is very permanent, and most of its characteristics remain for thousands of years after the race bearing them has changed its habitat. Even when the race has been practically bred out by competing races, better adapted to the changed conditions, all the old characters reappear from time to time, sometimes singly, but occasionally all together." For example, the skull of Jonathan Wild reproduces all the characters of the Long Barrow race. "Finally, I must admit that the skull of the modern twentieth-century Londoner has changed from that of the eighteenth, but it is in the direction of increased breadth and shortness, and the change is due, I believe, to admixture with the Central European or Alpine race, which in the last two centuries has been pouring into this country in ever-increasing quantities."

As stated in NATURE of December 30, 1920 (vol. 106, p. 583), the first Pan-Pacific Scientific Conference resolved that fuller knowledge of the history and culture of the Polynesian race was essential to the solution of the ethnographic problems of the Pacific. The Report of the Director of the Bishop Museum, Honolulu, for 1920, just received, informs us that Mr. Bayard Dominick, of New York, is financing an expedition for the study of Polynesian origin and migration. This is organised by the Bishop Museum in conjunction with authorities from countries bordering on the Pacific. During 1920–21 parties have been stationed on the Marquesas, Austral, Tongan, and Hawaian Islands to establish standards of physical form, material culture, traditions, and language of the Polynesians. During 1921–22 a boat with a scientific staff is making observations in selected localities along the route Honolulu, Wake, Marshall, Eastern Carolines, Gilbert, Ellice, Samoa, Tonga, Friendly, Cook, and Society Islands, returning to Honolulu *via* Tongareva, Malden, Christmas, and Fanning Islands. The Bishop Museum acts as permanent representative of the first conference. Its director, Prof. H. E. Gregory, is chairman of a committee to arrange for future conferences, and associated with him are E. C. Andrews (Australia), C. M. Fraser (Canada), F. Omori (Japan), Charles Chilton (New Zealand), and T. Wayland Vaughan (United States).

THE latest issue of the *Archiv für Kriminologie* (Bd. 72, Heft 3–4) contains an important article by Prof. W. Ostwald, of Leipzig, entitled "Das System der Kriminologie," in which he attempts a classification of the subject-matter of criminology. He starts from a classification of science as a whole under three main headings: (1) Mathetics, subdivided into logic, mathematics, geometry, and kinematics; (2) energetics, subdivided into mechanics, physics, and chemistry; and (3) biotics, subdivided into physiology, psychology, and sociology. Applying this classification to criminological studies, he arrives at a schedule in which criminology in the more restricted sense falls under sociology, while the contributions of sciences auxiliary to criminology proper, such as criminal anthropology and criminal psychology, fall under the earlier and more general headings. Prof. Ostwald gives an example of the working of his scheme as applied to a large number of titles taken from criminological literature. As an attempt to introduce some sort of order on a logical basis in a subject with a wide scope and a vast literature, this classification will be welcome to students. Its terminology, however, if only for the sake of clearness, needs revision and amplification. As it stands at present the titles of the divisions of the schedule are not sufficiently indicative of their content to be of much practical utility as guides. In addition to Prof. Ostwald's paper, this issue of the *Archiv* contains a number of interesting contributions by prominent criminologists, among the more noteworthy being a long account by J. P. L. Hulst, of Leyden, of a number of cases of necrophilia, an examination by Prof. Allfeld and Prof. von Beling of a proposal put forward by Dr. R. Hindl for the treatment of habitual criminals, and a valuable note by Mr. Arthur Macdonald, of Washington, on the possibility of using police records, particularly records for identification purposes, for the anthropological study of the population.

WE have received the Report of the Bacteriological Section, State Board of Agriculture, U.S.A., for 1920. Much work has been done on the keeping qualities of butters, the decomposition of peat, silage production, bovine infectious abortion, various fermentations, soil and food. For the isolation of the *Bacillus abortus*, the causative organism of infectious abortion, a liver agar medium is recommended with an addition of 1 in 10,000 gentian violet. The medium should have a hydrogen-ion concentration of between 6·6 and 6·4, and the cultivation should be conducted in a closed chamber, in which 10 per cent. of the air is replaced by carbon dioxide.

AN account of the brachyuran crabs collected by the American Museum Congo Expedition has been published recently by Miss Mary J. Rathbun (Bull. Amer. Mus. Nat. Hist., vol. 43, pp. 379–474, 30 plates). The collection contains about 3000 specimens belonging to forty-three species, and the large series has enabled the author to define many of the previously known species with greater accuracy. Three of the four species of Callinectes known to occur on the West African coast are well represented in the collection, and details of their systematic characters are given. The author states that the collection of land crabs (Cardisoma), about 120 specimens, serves to demonstrate that certain differences between the African species, *Cardisoma armatum*, and the American species, *Cardisoma guanhumi*, are constant. The river crabs (Potamonidæ) form the most important part of the collection, and are represented by nine species, four of which are new. Notes on the bionomics of these crabs are added by Mr. H. Lang, leader of the expedition.

THE rodents of North America, prairie dogs, ground squirrels, pocket gophers, jack-rabbits, field mice and rats, are responsible for depredations amounting to 100,000,000*l*. a year to field crops, pasturage, and stored products. Mr. W. B. Bell, in the Year-Book of the United States Department of Agriculture for 1920, gives an account of the damage which they do, and of the measures taken to control or eradicate them. The matter was first taken up by the Biological Survey, which devised means both of prevention and cure. By their field operations and by demonstration plots they were able to convince the farmer and stockman of the efficacy of their measures, and in this way they won their co-operation, as well as financial support from the individual States of North America. The work now comprises thoroughly organised aggressive campaigns in sixteen of the Western States. The two chief methods of control are poisoning by strychnine and organised drives, and the methods of prevention include the erection of rodent-proof fencing and the introduction of rat-proof devices into buildings used for storage purposes. Mr. Bell's account gives a vivid idea of the menace which these rodents are to the food supplies of North America, and the valuable results obtained by organised effort on a comprehensive scale for their control and eradication. The menace is equally serious in this country, and the measures adopted in America deserve the serious consideration of the Government and local authorities here.

WE have received an interesting letter from Mr. J. Anderson, of Sewerby, near Bridlington, stating that one of a fine group of the Chilean tree, *Araucaria imbricata*, at Sewerby House had produced a large number of seeds from which healthy young plants have been raised; he asks if this is an unusual occurrence. Mr. W. J. Bean, Royal Botanic Gardens, Kew, informs us that this is not a rare occurrence, and for many years past trees in various parts of the country have borne fertile seeds. He remembers so long ago as 1906 seeing self-sown young plants at Castle Kennedy, in Wigtownshire, growing beneath the trees from which the seeds had fallen. Similar self-sown seedlings may be seen at Strathfieldsaye, the seat of the Duke of Wellington; and other places where fertile seeds have been developed are Beauport, Tortworth, Castlehill, in North Devon, and Bicton, in South Devon. Mr. Anderson also states that some twenty-five or thirty years ago one of the trees "bled to death" from a scar caused by the breaking away of a branch. This also has been known to happen before. A case is known where a tree died from a running wound made at its base by the scythe of a workman mowing the grass. Mr. Anderson, however, records an interesting fact that we do not remember to have seen noted before: when the roots of the dead tree were being removed the workmen dug up large quantities of resin which had set into hard, amber-like masses. The seeds are eaten by the Araucanos and other Indian tribes in Chile. Mr. H. J. Elwes, who visited the native forests of this tree in 1901–2, states that he has eaten them both roasted and boiled and found them very palatable, with a nutty flavour somewhat like that of almonds.

DEVELOPMENT of the petroleum resources in Alaska has been, as we might have expected from the nature of the country, an extremely slow and somewhat costly matter; the comparative inaccessibility of the oil-bearing territory and the rigorous climatic conditions have combined to retard progress to the point of questioning the justification of a continuance of operations. The first well was brought in at Katalla in 1901, and was followed by a short-lived oil boom, afterwards depressed by the wonderful results of Californian development; since that year forty wells have been drilled in Alaska, thirty-one in the Katalla field and the remainder in other prospects, including the Iniskin Bay and Cold Bay districts; Yakataga, on the Pacific seaboard, and Smith Bay, on the Arctic coast, are mentioned as further areas where indications are good. The total production to date amounts to some 56,000 barrels of crude oil which has been refined and used locally; the oil is of paraffin base, of specific gravity varying from 41° to 45° (Baumé), high in petrol, and with no sulphur content; it is obtained from Tertiary beds the structure of which is at present doubtful. Geological exploration is a matter of great difficulty, and the results set forth in the preliminary report on the country (U.S. Geol.

Surv., Bull. 719) can only be regarded as tentative. It is doubtful whether Alaska will ever take rank as an important producing country, but oil will probably be obtained in sufficient quantity to meet local requirements.

Southport Corporation has issued its annual report of meteorological observations for the year 1920, the results and discussions being carried out by Mr. Joseph Baxendell, meteorologist to the corporation. The report is circulated by the Air Ministry through the Meteorological Office and by the Corporation of Southport, as was done with the results for the year 1919. For many years these reports have stood out as specimens to show what can be done by corporations in England when there is a desire to aid in the advance of meteorology. The observations for 1920 are admirably treated, but there is rather less discussion of the observations than in some recent years, possibly due to the real lack of sufficient scientific assistants; it is stated in the report that a research computer is greatly needed. Research is going on to establish the trustworthiness of a five-year periodicity for wind direction, temperature, and rain in north-west England, and observations are contributed to the Meteorological Office for the daily, weekly, and monthly weather reports. The mean temperature of the complete year was 49·2° F., or 1° above the forty-five years' average. The total duration of sunshine in 1920 was 1277 hours, or 279 hours less than a twenty years' local average, and the smallest annual value yet recorded at Southport. North-westerly winds were deficient throughout the year, the deficiency amounting to little less than double the largest previous annual deficiency from that direction. The dominant feature of the year was the exceptional prevalence of winds from the southern half of the compass. The total rainfall for the year was 34·08 in., which is 1·24 in. above the normal. Observations of diurnal variation of wind direction and velocity, air temperature, and sunshine are of especial interest, as are also the observations of atmospheric pollution.

Wind observations in various Finnish lightships taken between 1914 and 1920 (Ström- och Vindobservationer vid Fyrskeppen) have been published by Dr. G. Granqvist in *Havsforsknings Institutets*, Skrift No. 10, 1921. The observations are from fourteen lightships in the Gulfs of Bothnia and Finland and one in Lake Ladoga. Most of them ceased late in 1914 and throughout the years 1915 to 1918, but the series is fairly complete in 1919 and 1920. The data, which were taken three times daily, are given in detail.

Several useful pamphlets on map projections have been issued by the Department of Commerce of the United States Coast and Geodetic Survey. A study of map projection in general (Special Publication No. 60) treats in a few pages with numerous illustrations of the fundamental ideas underlying the subject. A larger work is "Elements of Map Projection," by C. H. Deetz and O. S. Adams (Special Publication No. 68), which deals both with the theoretical side of the subject and the practical details of the construction of some of the most important projections. It is copiously illustrated with maps and diagrams and supplied with tables for the construction of Mercator's projection. At the low price of 50 cents it should find ready acceptance in this country. The third pamphlet (No. 67) deals with latitude developments connected with geodesy and cartography, and includes tables for the Lambert equal-area meridional projection.

The paper read by Sir Vincent Raven before the North-East Coast Institution of Engineers and Shipbuilders on December 16 last is noteworthy, as it makes out a strong case in favour of electric traction on railways. The author is the chief mechanical engineer to the North-Eastern Railway Co., which is about to electrify 250 miles of its main-line system. It is well known that the steam locomotive engine has only half the economy of the steam stationary engine of the same size owing to the great difference in the economy of the boilers in the two cases. The question to be considered, therefore, is whether the great economy that could be effected by generating power on a large scale in a fixed station would be counterbalanced by the unavoidable losses in transmission and the interest on the capital cost of the transmission lines. The author quotes data which prove that electric traction is in nearly every case the more economical. As the North-Eastern Railway Co. intend to purchase their electricity from the supply companies operating in the district, a probable result will be the reduction in the price of electricity to ordinary consumers. This happened in 1904 when the Tyneside passenger lines were electrified.

In a recent catalogue of the Snook apparatus by Messrs. Newton and Wright, Ltd., we find useful descriptions of two models of this well-known and trustworthy transformer; the Standard model is intended for radiographic work only, the Universal for all purposes, including deep therapy. This latter model is insulated with oil, and is also suitable for X-ray tests upon metals and for the many industrial purposes for which X-rays are being used. A brief description of a new time switch is given; this is based entirely on mechanical principles, and should form a useful addition to a radiographic outfit, for it has a working range of automatic action from 8 seconds to 1/30th of a second.

Messrs. J. Woolley, Sons and Co., Ltd., of 76 Deansgate, Manchester, have issued their annual pocket-book, "The Scientist's Reference Book and Diary for 1922," price 3*s*. 6*d*. In addition to the usual information given in diaries, there are brief particulars of the more important scientific societies and departments and numerous tables of physical and chemical constants which make the little volume extremely useful to teachers of science and other scientific workers.

Dr. A. S. Russell has written, for publication by Mr. John Murray, "The Chemistry of the Radio-elements." The work is intended to describe in a simple and concise form the main facts concerning the chemical properties of the radio-elements and the bearing of this knowledge upon inorganic chemistry and theories of the structure of the atom. Among the topics dealt with are the relation of the radio-elements to the periodic system of classification, the properties of isotopes, the separation and purification of individual elements, and the analytical chemistry of uranium, thorium, and radium.

THE spring announcements of the Cambridge University Press contain several items of scientific interest, among which is the first volume, bearing the sub-title Foundations, of a forthcoming book by Prof. H. F. Baker entitled "Principles of Geometry." We learn from the preface that the work seeks to introduce the reader to those parts of geometry which precede the theory of higher plane curves and of irrational surfaces. Vol. 1 is devoted to the indispensable logical preliminaries. It assumes only those relations of position for points, lines, and planes which, furnished with a pencil, a ruler, some rods, and some string, a student may learn by drawing diagrams and making models. It seeks to set these relations in an ordered framework of deduction, gradually rendered comprehensive and precise enough to include all the later theory; to this end it puts aside, at first, most of those intricate details which make up the burden of what is generally called elementary geometry. Later volumes will deal, on the basis of the results obtained in this volume, with conics (and circles), with quadric surfaces and cubic curves in space, and with cubic surfaces and certain quartic surfaces.

Our Astronomical Column.

THE ORIGIN OF BINARY STARS.—Dr. J. H. Jeans discusses this question in the January issue of *Scientia*. He notes that binaries are of such frequent occurrence (practically half the stars) that we cannot regard them as freaks or abnormalities, but must seek for some explanation of very wide applicability. He considers three possible origins: (1) through fission of a single mass; (2) formation of adjacent nuclei in the original nebula, sufficiently close to each other to be held together gravitationally; and (3) capture, arising from the appulse of two stars originally independent. The last could lead to capture only if a resisting medium were present; moreover, there would be far too few close appulses to explain any appreciable fraction of the existing binaries. Dr. Jeans estimates that in a universe of a thousand million stars there would be ten thousand captures in a thousand million years. The first suggestion is shown to be possible only when a certain density of the rotating star has been attained (probably about that of the stars of B type). It is shown that this explanation accords well with the observed phenomena in the case of spectroscopic binaries, notably the low eccentricity of their orbits. Russell and others, however, have shown that the latus rectum of the orbit cannot increase very greatly, save under the action of considerable external forces, which are certainly not present now, and could only have been present in the past if the interstellar distances were then much smaller.

A test of the fission theory is afforded by triple systems, which generally consist of a close pair with a distant companion. Prof. Russell showed that the density of the central star would be at least 380 times greater at the second fission than at the first, which leads to such an improbable figure as to throw very grave doubts on the fission theory in the case of the wide pairs. Hence the second suggestion is taken to be by far the most probable explanation of the latter pairs. It must, however, be considered to indicate the *how* rather than the *why*; for the question remains why there should be so marked a tendency for nebular condensations to occur in pairs.

Dr. Jeans notes that star groups with common motion, such as the Taurus and Ursa Major clusters, can be most readily explained as arising from adjacent condensations in a primitive nebula; in these cases, however, the mutual distances were so great that the stars were outside each other's field of gravitational control.

THE ORBIT OF CASTOR.—Dr. W. Doberck gives in the centenary number of *Astron. Nachr.* an explanation of Villarceau's method of computing double-star orbits, which is analogous to Laplace's method for planetary orbits. He illustrates it by revising the orbit of Castor from the following four positions: 1719·84, 357·0° (4·82″); 1832·0, 259·0°, 4·61″; 1880·0, 234·5°, 5·63″; 1920·0, 216·0°, 5·03″. The first distance was not observed, but calculated. The author utilises his earlier orbit to shorten the approximations, and obtains the following orbit: ☊ 222° 7′, λ 67° 19′, γ 116° 6′, e 0·2875, P 477·5 years, T 1960·51, a 6·573″.

Predicted places, 1930·0, 210·4°, 4·58″; 1940·0, 203·0°, 3·98″. Owing to the approach to periastron the motion is accelerating It should be possible to obtain the relative masses of the components before very long; this is desirable as a check on the result suggested by the spectroscopic observations, which give the faint star six times the mass of the bright one.

SPECTRUM OF α CYGNI.—This spectrum is interesting from its relationship to the spectra of novæ. Its classification is A 2 (peculiar), and Dr. W. H. Wright has made a special study of the ultra-violet region, which is described in Lick Obs. Bull. No. 332. A spectrograph with two quartz prisms was attached to the Crossley reflector, and three photographs taken on June 11, 1921, two of them being on films which were bent to correspond with the curvature of the field. The limiting wave-lengths are 3245 to 4102, and 184 lines are recorded in the table, most of them being identified with known metallic lines, but they are unusually sharp and narrow compared with other A spectra. The hydrogen Balmer series is complete from $H\delta$ to $H\omega$. Dr. Wright states that the resemblance to the spectra of novæ is still more striking in the ultra-violet than in the visual region. A curve is given of the spectral intensity on the photographs: it falls very steeply between 3750 and 3650, then slowly and uniformly to 3245. The paper also contains some measurements of the red end of the α Cygni spectrum taken on stained plates. It is incidentally proved that some lines announced in this region by Dr. Waterman from photographs with a grating spectrograph really belonged to the blue region of the overlapping third-order spectrum.